vesicles. Injection made though the ambulacral vessels does not generally pass the inner marginal vessel, except when the injection is made with a rather strong pressure. We then find that the vesicles are completely inflated by the material; by means of the pressure the latter has been able to traverse the tissue of the vesicles to penetrate into the superior ring.

As in the *Spatangi*, there are two vessels in each ambulacral zone, a superficial and a deep-seated vessel, and each of them emits a branch to each ambulacral vesicle. These two vessels are independent of the nervous band which is closely applied to the wall of the test. At the level of the lower margin of the lantern the ambulacral vessels, from being double, become simple, and ascend along the pyramids to debouch into the inferior ring.

When an injection is made through the superficial ambulacral vessel or through the deep-seated one, the same result will be arrived at; that is to say, the inferior periœsophageal ring will be filled.

Teuscher, who also admits the existence of two ambulacral vessels (although, according to him, one of them surrounds the nervous band), thought that in transverse sections of the pharynx he recognized the section of five vessels; he believed that these five vessels were the continuation in the interior of the lantern of his perinervian ambulacral vessels, and that they opened into the superior periœsophageal ring. Now, these vessels do not exist, and the superior œsophageal ring is in communication with the ambulacral vessels only by the intermediation of the Polian vesicles.

The anatomical arrangements of which I have just given a summary, namely the existence of two periœsophageal rings, the existence of two vessels in each ambulacral zone, the complete independence of the nervous and circulatory systems, and the communication of the excretory organ with the circulatory system by the intervention of the sand-canal, approach the facts which I have already indicated in the irregular Echinoidea.—*Comptes Rendus*, Sept. 4, 1882, p. 459.

On Lieberkuehnia, *a Freshwater Multinucleated Rhizopod.*

By E. Maupas.

When, in July 1879, I presented to the Academy a note on some multinucleated animal and vegetable protorganisms, I expressed my opinion that a number of new facts would certainly have to be added to those already known concerning multinucleated cells. Among the Algæ I mentioned the group of Siphoneæ as being likely to possess the same structure. This supposition was no longer such at the time I expressed it, as, contemporaneously with my notice, there appeared in Germany a memoir by Fr. Schmitz, in which that skilful observer pointed out the plurality of nuclei in several of the Algæ belonging to this group. Since then the researches of Treub, Berthold, Johow, and Guignard have still further increased the number of cases of nuclear plurality in vegetable cells.

I now submit a new and similar case observed in a Protozoan already known, but hitherto insufficiently investigated. Its organization is, moreover, so curious that its description will be gladly received by those who are interested in the morphology of unicellular organisms.

This Protozoan, which I found in the basin of the experimental garden at Hamma, near Algiers, is *Lieberkuehnia*, a freshwater rhizopod first described by Claparède and Lachmann, and afterwards reexamined by Cienkowski. This latter author did not identify the forms observed by him with those of Claparède and Lachmann, and called them by the new name of *Gromia paludosa*; but this mistake has already been corrected by Bütschli in his 'Protozoa' (p. 106). The observations of these authors, although extremely interesting, are far from being complete; they are moreover erroneous in some essential points.

The form of the body is variable, and may be perfectly spherical, ovoid, oblong, or even fusiform. Each individual can assume all these forms; and when the same specimen is under observation during several days, it is seen to pass through all these changes. These changes take place very slowly. The carapace is very transparent, and is closely applied to the surface of the body, and changes with it, lengthening, expanding, contracting, and returning to the spherical form at the same time with it. It also shares in the fissiparous division. I therefore cannot regard it as a true carapace in the same sense as that of the *Arcellæ* and the *Difflugiæ*. In these latter the carapace is a product of chitinous secretion of the nature of a skeleton, and has a very different morphological value. In *Lieberkuehnia* the seeming carapace is in reality only an integument or ectosarc, which can be isolated by certain reagents from the endosarc, but which resists less than the latter certain dissolving reagents.

The pseudopodia spread out at the extremity of a laterally inserted peduncle. They are capable of extending to a great distance. I have measured some which attained the length of 2·26 millim., the body of the animal having a diameter of from 0·15 to 0·16 millim. The circulatory movement of the sarcode is one of the most rapid that I have yet observed. The granules move through a space of 0·66 millim. a minute, the surrounding temperature being 23° C. (73° F.). The Infusoria which strike against the meshes of their network are arrested and rendered motionless, as has already been observed in the case of many other Rhizopods. In this way *Lieberkuehnia* is able to capture large Infusoria, such as *Paramecium aurelia*. The Infusoria when taken are absorbed in various ways: sometimes they are swallowed whole; sometimes, on the contrary, the sarcode of the pseudopodia envelops them on every side and constitutes around them a digestive vacuole, in which they are dissolved outside of, and frequently at some distance from, the body. They do not reach this till later on, when they are already assimilated to the substance of the pseudopodia in whose circulatory movement they disappear. The digestion takes place and is finished entirely out-

side of the body. With small Infusoria, such as *Cyclidium glaucoma*, the operation hardly lasts five or six minutes; but *Paramecium aurelia* resists more than an hour before it is dissolved and disappears by being drawn into the current of the pseudopodia. The sarcode of the mass of the body is in constant motion. This motion does not take place regularly in the same direction, like the cyclosis in *Paramecium aurelia*. It is quite as rapid as in that Infusorium; but splits up into currents with diverse and varying directions. This sarcode is hollowed out by numerous vacuoles of different volume and size, which are carried along by the currents, in which they are often seen to change their form and sometimes to amalgamate one with another. They always end by coming to the periphery of the body, where they contract in a similar manner to that of the so-called contractile vacuoles. *Lieberkuehnia* is therefore not, as has been stated, destitute of these organs of excretion. It is, on the contrary, perhaps more richly furnished with them than many other Protozoa. There is simply this difference, that the contractile vacuoles are neither permanent nor localized in any region of the body, every part of which may serve as a basis for their formation.

Lieberkuehnia, also contrary to what has been asserted, likewise possesses a great number of *nuclei* disseminated in the substance of the body; these nuclei are spherical, and measure 0·004 millim. I have already described another Rhizopod* likewise combining in its structure the instability of the contractile vacuoles and the multiplicity of nuclei. Further researches will undoubtedly increase the number of examples of this type of organization; and every thing leads me to believe that the *Biomyxa vagans* of Leidy† will, when more fully examined, show the same structure. The American naturalist has correctly recognized the numerous ephemeral vacuoles; but the nuclei have escaped his notice. These types are further characterized by the great mobility of their sarcode, by the incessant variability of their general outlines, and by the large development of their pseudopodia.

Lieberkuehnia increases by transverse division, which has been well described by Cienkowski. I will state, in addition to his observations, that I have seen individuals divide, not only into two but into three. The body lengthened out into a long spindle, which, after the formation of two new peduncles bearing pseudopodia, became constricted at two points, and was thus divided into three nearly equal segments. One specimen, resulting from one of these divisions into three, developed, as soon as it was detached, a second peduncle bearing pseudopodia situated at the opposite extremity to the one it already possessed. It continued thus to live with two places of emission of largely expanded pseudopodia. I observed it in this state for more than a day without any further changes taking place than those slow ones in the form of the body above mentioned. In this, therefore, there was no preparation for a

* See 'Comptes Rendus,' t. lxxxix. (1879), p. 252.

† Freshwater Rhizopods of North America, p. 282.

further fissiparous division. This *Lieberkuehnia*, so constituted, with its two places of emission of pseudopodia situated at the two opposite extremities, would answer to the morphological type which has served to establish the family of the Amphistomina. It may be considered therefore one of those intermediate forms which connect separated families.—*Comptes Rendus*, July 24, 1882, p. 191.

On the Development of the Alcyonaria.

By MM. A. Kowalewsky and A. F. Marion.

During the months of May, June, and July we studied at Marseilles the embryogeny of three Alcyonida, namely two *Clavulariæ* and *Sympodium coralloides*. The segmentation, which had not previously been completely observed in any Alcyonarian, was seen and followed in all its phases in the ova deposited by *Clavularia crassa*. The fecundated ovum remains for some time without dividing. At this period the principal histological reagents (Kleinenberg's liquid, osmic acid, chromic acid, carmine with borax) are powerless to show any nucleus in its interior, while subsequently, when the segmentation is completed, the nuclei of the cells, notwithstanding their extreme minuteness, are easily recognized. Sections of the fecundated ovum show simply a finely granular peripheral protoplasmic zone and a central mass of fatty nutritive vitellus. The segmentation is rapid and of a quite unexpected nature. The primitive nucleus must be unable at its first division to carry with it the whole mass of the vitellus as nutritive substance. The derived nuclei undoubtedly emigrate towards the periphery, as is the case in some Crustacea; and when they are numerous enough, they determine a splitting-up of the vitellus, which becomes rapidly marked, producing segmentation-balls which penetrate angularly to the centre of the ovum. There is consequently no division into two. The ovum appears all at once broken up into at least six balls. After this division the distinction between a central nutritive part, and a peripheral evolutive part persists in the segmentation-balls themselves. These first balls, the number of which has increased, divide transversely, so as to constitute a peripheral layer of evolutive cells, and a central mass of cells in which the nutritive vitellus predominates. The same characters are still shown when the number of cells has considerably increased by the progress of the segmentation. The peripheral protoplasmic cells soon become regular, and form a very distinct ectodermic lamella. Beneath this the nearest layer of deutoplasmic cells arranges itself into a second lamella, the endoderm. The remainder of the deutoplasmic cells still occupy the centre of the ovum; but the contours of these elements begin to grow indistinct, and we soon see that, under the influence of degenerescence, a great number of the nuclei themselves are destroyed. The mass of vitellus in reserve decreases pretty rapidly; and empty spaces, gradually becoming larger, appear in the centre of the embryo, which acquires an ovoid form. The larva, when it issues from the ovum with its characteristic aspect, still